

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Ramesh Sundaram et al.
Filed : Herewith
For : GLIDE HEAD FOR ASPERITY
DETECTION
Docket No.: S01.12-0460

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09/176580

TRANSMITTAL LETTER

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The following paper(s) and/or fee(s) are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" addressed to BOX PATENT APPLICATION, Assistant Commissioner for Patents, Washington, D.C. 20231:

1. Our checks in the amount of \$790.00 and \$40.00
2. Fee Calculation Sheet
3. Patent Application comprising the following pages:
 - 1 Abstract
 - 16 Specification
 - 3 Claims
4. 3 Sheets of drawings
5. Executed Declaration and Power of Attorney (3 pages)
6. Executed Assignment and Recordation Form Cover Sheet

Respectfully submitted,

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PSD:sa

FEE CALCULATION SHEET

Attorney Docket No.

S01.12-0460

Sir:

Express Mail No. EL024160792US
Date of Deposit: October 21, 1998

The fees due for filing in the patent application of:

Inventor(s) : Ramesh Sundaram and Wei Yao

Title : GLIDE HEAD FOR ASPERITY DETECTION

Are calculated as follows:

Reduced fees are applicable based on the enclosed Verified Statement claiming Small Entity status.

(Col. 1)		(Col. 2)	Small Entity		Large Entity		
FOR:	NO. FILED	NO. EXTRA	RATE	FEE	OR	RATE	FEE
BASIC FEE			=	\$395		=	\$790
TOTAL CLAIMS	20 - 20 =	0*	X 11 =	\$		X 22 =	\$
INDEP CLAIMS	3 - 3 =	0*	X 41 =	\$		X 82 =	\$
MULTIPLE DEPENDENT CLAIM PRESENTED			+ 135 =	\$		+ 270 =	\$
* If the difference in Col. 1 is less than zero, enter "0" in Col.			TOTAL	\$		TOTAL	\$790

Please charge Deposit Account No. 23-1123 in the amount of \$_____. This sheet is submitted in triplicate.

A check in the amount of \$790.00 to cover the filing fee is enclosed.

The Commissioner is authorized to charge payment of any patent application processing or filing fees under 37 CFR §§ 1.16 and 1.17 or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

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CROSS REFERENCE TO RELATED APPLICATIONS

BACKGROUND OF THE INVENTION

The present invention relates generally to glide heads for evaluating glide quality of a disc surface, and to related methods. More particularly, the present invention relates to a glide head with a thermal transducer for detecting defects on a disc surface.

Glide tests are used to determine if a given disc meets the required glide quality. The glide quality of a disc is related to the disc smoothness, although other defects also may alter glide quality. In particular, tests are used by computer disc manufacturers to control and assure the quality of the disc media. Generally, all hard drive discs are tested before shipment. During a glide test, the test head or slider flies over a disc surface generally at a predetermined clearance from the disc surface, known as the glide height or fly height. The glide head or

slider includes a transducer that detects interactions between the disc and the glide head due to defects on the disc surface.

5 The glide heads are selectively moved under the control of electronic circuitry to any one of a plurality of circular, concentric data tracks on the disc surface by an actuator device. Each slider body includes an air bearing surface (ABS). As the disc rotates, the disc drags air beneath the ABS, which
10 develops a lifting force that causes the glide head to lift and fly above the disc surface. Glide heads generally are designed to have a fly height that is sensitive to the linear velocity of the disc surface relative to the glide head. For example, to detect
15 smaller defects on a disc surface, the disc velocity can be decreased to decrease the fly height of the glide head.

A transducer can be used to detect contacts between the glide head and defects. Generally,
20 piezoelectric transducers are used to detect vibrations that result from contact between a glide head and a disc defect. Using glide heads, the process of mapping disc defects while changing the fly height of the head requires several scans at different head fly heights to
25 map the entire range of defects. As the speed is changed, the response of the specially designed glide head also changes. For example, if the speed is reduced, the energy of the impact is reduced, thus making it more difficult to calibrate to the defect size
30 and height.

SUMMARY OF THE INVENTION

In one aspect, the invention features an asperity detection slider including an air bearing surface and a thermal transducer. The thermal

transducer is generally planar and is oriented along the air-bearing surface.

In another aspect the invention features, a method of producing an asperity detection slider, the method including depositing a thermal transducer along an air bearing surface of the slider.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic, top perspective view of a glide tester incorporating an improved glide head, where a disc is shown with phantom lines such that structure below the disc is visible.

Fig. 2 is a bottom view of an embodiment of an slider with a thermal transducer located on the air bearing surface.

Fig. 3 is a bottom view of another embodiment of an slider where a thermal transducer is located on the air bearing surface away from the slider's rear edge.

Fig. 4 is a bottom view of an embodiment of an slider where a thermal transducer covers a substantial portion of a rail on the air bearing surface.

Fig. 5 is a bottom view of a slider having two different configurations of multiple thermal transducers located along a rail on the air bearing surface.

Fig. 6 is a bottom view of an slider having an alternative configuration of multiple thermal transducers located along a rail on the air bearing surface.

Fig. 7 is a schematic perspective view of an slider having both a thermal transducer and a piezoelectric transducer.

Fig. 8 is a schematic, fragmentary perspective view of a wafer with thermal transducers located on the

surface of the wafer at locations that are contoured to be an air bearing surface of the ultimate sliders.

Fig. 9 is a schematic, perspective view of an slider with a thermal transducer along a rail on the air bearing surface and electrically conductive pads deposited on a rear edge prior to the addition of protective material over the pads.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

By placing a thermal transducer as an defect/asperity sensor on the air bearing surface of a slider/glide head, glide testing can be performed efficiently with a high sensitivity. After a defect strikes the thermal transducer, a resistance spike is detected to provide a signature that a defect has contacted the glide head. Furthermore, thermal transducers oriented along the air bearing surface can present a large contact area on the air bearing surface. Thus, a glide test can be performed efficiently since asperities with a greater range of heights strike the thermal transducer when contacting the glide head. A plurality of thermal transducers on the air bearing surface can be used to assess the distribution of defect heights.

Glide tests performed with piezoelectric (PZT) transducers can be accomplished efficiently since defects with a wide range of heights are detected in one pass over a section of the disc. It is believed, though, that glide heads with PZT transducers may give positive readings when defects pass near the glide head even when they do not strike. Thus, PZT based glide heads may result in false positive readings for defects.

Magnetoresistive (MR) type sensors used in read/write heads can operate as thermal transducers. In contrast with defect sensors placed on the air bearing

surface, MR sensors in read/write heads are located on a side of the slider adjacent the air bearing surface and have only an edge of the MR sensor in contact with the air bearing surface. After contact with an defect, the heat generated by the contact changes the resistive properties of the MR sensor. As a result, the measurement of the resistance of the MR transducer biased by a constant current source is distorted by a spike and subsequent decay. Because of the narrow profile along the air bearing surface presented by the MR sensor in a read/write head, few defects will strike the glide head at the MR sensor with the MR sensor at the trailing edge side. Collisions with defects that strike such a glide head away from the MR sensor may not produce a voltage spike in the resistance measurement.

Thus, thermal defect detection methods using either MR read/write heads having a narrow MR sensor track width, or asperity detection sliders adapted from MR read/write head designs having an increased MR sensor track width have inherent limitations. Using MR read/write heads, with track widths typically less than $2.5 \mu\text{M}$, the time for a full surface scan is extremely time consuming. Furthermore, standard MR read/write heads of the type used in disc drive systems are designed to reduce sensitivity to thermal asperity response by having increased fly heights and/or MR transducer recessed with respect to the air bearing surface. Specially designed thermal asperity heads can reduce the surface scan time and increase the thermal asperity response by using a somewhat wider MR sensor track, for example, $60 \mu\text{M}$. This wider MR sensor track still only covers a very small portion of the slider air bearing surface.

It is believed that thermal asperity detectors do not respond to near misses between a defect and the glide head. In particular, contact between the thermal transducer and a defect produces a characteristic resistance spike that may not be produced by contact between other portions of the slider and the defect. Thus, thermal transducers by their nature are inherently very sensitive to contact with a defect, while rarely giving a false positive reading. Thermal transducers placed on the air-bearing surface can take advantage of both a high sensitivity with respect to detecting actual contact with an asperity and an ability to detect simultaneously a larger range of defect heights. In this way, the glide test can be performed with an efficiency comparable to PZT based glide tests while taking advantage of the high sensitivity and specificity obtained with a thermal transducer.

Under previous practices for slider/glide head production, one of the cut surfaces of the slider formed from a wafer is formed into the air-bearing surface. If a cut surface is formed into the air bearing surface, a thermal transducer formed along an edge of the slider can be placed on the wafer prior to cutting the slider from the wafer. A novel approach to the production of glide heads involves using a very smooth surface of the wafer as the air bearing surface. The cut edges of the wafer become the sides of the slider.

Using this alternative slider production procedure, thermal transducers can be placed on the air-bearing surface at the wafer level prior to cutting the individual sliders. Thermal transducer application on the air bearing surface provides for the performance of many processing steps at the wafer level. In particular, the placement of the thermal transducer on

the air bearing surface can be performed more efficiently at the wafer level prior to cutting individual sliders from the wafer.

5 The thermal transducers are made from materials that alter their electrical resistance in response to a temperature change. To complete the asperity detector, the thermal transducer is connected to a circuit that provides for the measurement of the electrical resistance of the material in the transducer
10 on the air bearing surface. To form the electrical circuit, electrical conducting pads can be placed along an edge of the slider to connect electrically the air bearing surface with the top surface of the slider. A particular thermal transducer is connected to two
15 electrical pads to form a circuit through the transducer. The electrical circuit for resistance measurement is completed with connections to the electrical pads at the top of the slider body.

20 The air bearing surface of the slider generally includes contoured portions such as rails for aerodynamic performance. The thermal transducers generally are placed on an extended portion of the surface such that they will provide the point of contact with an asperity. A single large transducer can provide
25 for defect detection over a larger range of defect heights. The use of multiple thermal transducers can provide for grading of asperities, as described further below. Thus, selection of the number and placement of the thermal transducers involves a balance between the
30 processing complexity and the amount of information desired about the nature of the asperities. In preferred embodiment, the one or more thermal transducers cover an area of the air bearing surface from about 0.05 mm² to about 5.0 mm².

Referring to Fig. 1, a glide tester 100 includes a glide spinstand 102, an arm assembly drive 104, a suspension glide head assembly 106 and a controller 108. Glide spinstand 102 includes a spindle motor 110 and disc 114, shown in phantom lines. Spindle motor 110 supports and spins disc 114. Arm assembly drive 104 has a motorized drive 120 and an arm 122. Arm 122 has a support portion 124 that connects with motorized drive 120 and an extension portion 126 that extends over disc 114. Motorized drive 120 moves arm 122 either by lateral motion or by rotational motion to alter the radial position of suspension glide head assembly 106 along a disc 114 mounted on glide spinstand 102.

Suspension glide head assembly 106 generally includes suspension 128, gimbal 130 and glide head 132. Suspension 128 connects with arm 122. Glide head 132 is connected to suspension 128 by way of gimbal 130. Suspension 128 and gimbal 130 can have a variety of designs including conventional structures.

Controller 108 is connected to arm assembly drive 104 and spindle motor 110. Controller 108 correlates the position of arm 126 with the rotational speed of the spindle motor to maintain an approximately constant linear speed of slider 132 relative to the disc surface. Also, controller 108 correlates impact information detected by glide head 132 with a defect location on disc 114.

An embodiment of glide head/slider 132 is depicted in Fig. 2. Glide head 132 includes two rails 150, 152 on air bearing surface 154. A thermal transducer 156 is located on rail 150. Thermal transducer 156 is located near rear edge 158 of glide head 132. Electrically conducting pads 160, 162 provide

electrical contact between thermal transducer 156 and the top of glide head 132. Pads 160, 162 are connected to a measurement circuit at the top of the glide head such that the electrical resistance of thermal transducer 156 can be monitored. To improve the aerodynamic performance, steps 164, 166 are located near front edge 168 of glide head 132. The contoured features on the air bearing surface can be varied to achieve a desired aerodynamic performance of the glide head.

Thermal transducer 156 generally is made from material with an electrical resistance that varies with temperature. For example, materials such as NiFe alloy used to form magnetoresistive transducers also exhibit a thermal resistance effect. Preferred materials for producing the thermal transducers have a resistance that is relatively insensitive to magnetic fields since the defect measurement should not be sensitive to the magnetic field near the glide head. Preferred materials for forming the thermal transducer include, for example, nickel (Ni). Electrically conductive pads 160, 162 generally are made of conducting metal, alloy or metal compound. Electrically conductive pads 160, 162 are made preferably from gold.

The back edge of glide head 132 generally flies closer to the surface of the disc than the front edge. The pitch of glide head 132 is due to aerodynamic forces. Therefore, placement of the thermal transducer near the rear edge of the glide head provides for the detection of smaller asperities for a given fly height. Nevertheless, if desired the thermal transducer can be placed away from the rear edge. Such an alternative embodiment is depicted in Fig. 3. Thermal transducer 180 is located on rail 182. Electrical conduction

strips 184, 186 provide for electrical conduction between thermal transducer 180 and electrical conduction pads 188, 190. Electrical conduction pads 188, 190 provide a path of electrical conduction between strips 184, 186 and the top of glide head 132. Electrical conduction strips 184, 186 can be produced from electrically conductive metal, alloys, metal compounds or combinations thereof.

If the thermal transducers covers a substantial portion of the length of the glide head, defects with a wide range of heights strike the thermal transducers to produce a spike in the resistance of the transducer rather than striking a portion of the air bearing surface away from a transducer. Thus, another alternative embodiment of a glide head 132 is shown in Fig. 4. Thermal transducer 200 covers substantially all of rail 202 up to step 204. Thermal transducer 200 is in electrical contact with electrically conductive pads 206, 208.

A plurality of thermal transducers can be used on a single glide head. In preferred embodiments, a plurality of thermal transducers cover a substantial portion of the length of the glide head. In particular, the plurality of transducers can cover a substantial portion of a rail or other contour on the air bearing surface. The use of a suitably placed plurality of thermal transducers provide for the grading of defects by height. In other words, defects with different ranges of heights strike the glide head at different portions of the air bearing surface due to the pitch of the slide during use. Identification of the transducer that is struck indicates that the asperity has a height within a particular range.

Two embodiments for the placement of multiple transducers are indicated in Fig. 5. In the slider 132 of Fig. 5, rail 250 has one configuration of multiple transducers while rail 252 has a second configuration.

5 The placement of thermal transducers on more than one rail or other contour provides for the simultaneous detection of asperities on two portions of the disc surface. The motion of the slider across the disc surface can be adjusted accordingly.

10 Thermal transducers 254, 256, 258 are located on rail 250. Pad 260 and strip 262 provide electrical contact to a common ground for transducers 254, 256, 258. The use of a common ground reduces the space needed for electrical conduction strips and reduces
15 processing related to the deposition of conduction strips. Pads 264, 266, 268 and strips 270, 272, 274 provide electrical conduction to transducers 254, 256, 258, respectively, for resistance measurements.

Thermal transducers 290, 292 are located on
20 rail 252. Pads 294, 296 and conduction strips 298, 300 provide electrical connections to transducer 290. Similarly, pads 302, 304 and conduction strips 306, 308 provide electrical connections to transducer 292. In contrast with transducers 254, 256, 258, transducers
25 290, 292 do not share a common ground.

An alternative configuration of slider 132 having multiple thermal transducers is depicted in Fig. 6. Thermal transducers 320, 322, 324, 326 are located on rail 328. Transducers 320, 322, 324, 326 share a
30 common electrical ground provided by pad 330 and conductive strip 332. Pads 340, 342, 344, 346 provide the remaining electrical connections for transducers 320, 322, 324, 326, respectively, with the top of slider 132.

Pads 340, 342, 344, 346 are in electrical contact with conductive strips 348, 350, 352, 354. Conductive strips 348, 350, 352, 354 are located on plateau 356. Since transducers 320, 322, 324, 326 are
5 located on rail 328, electrical connection between the transducers and strips 348, 350, 352, 354 is established by electrically conductive pads 360, 362, 364, 366. The placement of conductive strips 248, 350, 352, 354 on plateau 356 provides for the coverage of a greater
10 portion of the surface of rail 328 with thermal transducers, although additional processing may be required to produce pads 360, 362, 364, 368 that provide electrical conduction between plateau 356 and rail 328.

A slider with a thermal transducer on the air
15 bearing surface can also have one or more additional transducers for the detection of defects. The use of multiple types of transducers provides for a comparison between measurements made with different types and/or configurations of transducers. For example, thermal
20 transducers which are particularly sensitive to actual strikes with an asperity can be used to evaluate whether piezoelectric transducers produce false positive signals from near misses with asperities.

Moreover, multiple types of transducers for
25 detecting defects can be used to provide more accurate defect detection. For example, the measurements from multiple types of transducers can be compared with a matrix of threshold values to evaluate whether a defect has been struck. In other words, if one transducer
30 produces a particular reading, a corresponding threshold value can be used for the other transducer to evaluate whether or not a defect was struck. A correlation of the measurements from the multiple transducers should reduce the number of false positive readings and false

negative readings. Thus, measurements can be made with a greater confidence level.

An embodiment of glide head 132 with different types of defect detecting transducers is depicted in Fig. 7. Glide head 132 includes rails 400, 402 along air bearing surface 404. Thermal transducer 406 is located on rail 402. Electrically conductive pads 408, 410 provide electrical conduction between transducer 406 and the top surface 412 of glide head 132. Pads 408, 410 are connected to resistance measurement circuit 414 for the evaluation of changes in resistance of transducer 406. Pads 408, 410 are located along or near rear edge 416 of glide head 132. Piezoelectric transducer 420 is located on wing 422 along top surface 412. Piezoelectric transducer 420 is connected to measurement circuit 424.

Regardless of the particular embodiment for the placement and number of the thermal transducers on the air bearing surface, the thermal transducers generally are formed on the air bearing surface following the contouring of the air bearing surface to form the gross shape of the air bearing surface. The thermal transducers can be deposited using any of the vacuum metal deposition techniques, such as sputtering. Conduction strips and conduction pads can be similarly deposited. Generally, the components are covered with a protective, electrically insulating layer such as diamond like carbon.

The order of processing depends on the approach used to produce the slider from a wafer. In conventional approaches, the air bearing surface is formed from a cut edge of the wafer. In these approaches, the electrically conductive pads can be deposited on the surface of the wafer prior to the

slicing of the wafer. The pads are positioned on the wafer surface such that they are along the rear edge of the slider after the sliders are cut from the wafer.

Following the cutting of the individual
5 sliders, the air bearing surface generally is subjected to one or more stages of lapping (e.g., rough lap, smooth lap and crown lap) to smooth the surface. Lapping generally involves mechanical, chemical and/or mechanical/chemical polishing. Following a desired
10 amount of lapping, the air bearing surface is contoured using thin layer deposition techniques, milling techniques such as ion milling, reactive ion milling or laser ablation, or a combination thereof. Following contouring, the thermal transducers and conductive
15 strips are applied to the air bearing surface. A protective coating then can be applied, if desired.

As noted above, a preferred approach for the production of sliders with thermal transducers on the air bearing surface involve the cutting of sliders from
20 wafers such that the air bearing surface of the sliders is formed from a surface of the wafer. Thus, a greater portion of the slider preparation is performed at the wafer level. In particular, the contouring of the air bearing surface and the placement of the thermal
25 transducers can be performed on the wafer prior to slicing the individual sliders. A portion of a wafer processed to produce sliders configured as shown in Fig. 2 is depicted in Fig. 8.

To form the sliders with the thermal
30 transducers located on the air bearing surface, a plurality of thermal transducers 500 can be applied along the smooth surface 502 of wafer 504, as shown in Fig. 8. Thermal transducers 500 are located on rails 506 contoured onto surface 502. Representative rails

506 are noted in Fig. 8. Additional transducers such as a piezoelectric transducer also can be placed on the opposite surface of the wafer prior to the slicing into individual sliders.

5 After completing the desired processing of the wafer surfaces, the wafer is "diced" or sliced along cutting alleys 508, as indicated in Fig. 8, to produce cut faces. A first cut produces a set of rows with each row containing a plurality of sliders. A second cut
10 along each row produces the individual sliders with four cut faces. A small quantity of material is lost along cutting alleys 508 during the slicing process.

 Following slicing, any desired lapping of the cut edge is performed. In this processing approach, the
15 electrically conductive pads 510, 512 of the slider are applied along the rear edge on the smoothed cut surface, as shown in Fig. 9. Additional details of the processing of sliders to produce an air bearing surface from a wafer surface is described in commonly assigned
20 and simultaneously filed patent application, __/__, __ to Sundaram et al., entitled "GLIDE HEADS AND METHODS FOR MAKING GLIDE HEADS," incorporated herein by reference.

 In order for asperity detection systems to be
25 useful to test discs with different tolerances, glide heads generally are designed to have fly heights that depend on the linear velocity of the slider relative to the disc surface. The fly height is selected such that asperities larger than a tolerance value strike the
30 glide head and preferably strike the thermal transducer. The linear velocity is set accordingly.

 Tolerance levels for asperity detection are generally set lower than tolerances established for disc flatness in actual operation since fly heights during

actual operation can be altered by additional factors including, for example, flutter of the spinning disc, spindle misalignment, high altitudes and temperature fluctuations. The glide head is swept across the disc
5 surface at a suitable speed such that the relevant portions of the disc surface are examined with the glide head. The rotation rate generally is varied as the asperity detection slider is moved to different radial positions along the disc to maintain the relative linear
10 velocity approximately constant.

The embodiments described above are intended to be illustrative and not limiting. Additional embodiments are within the claims below. Although the present invention has been described with reference to
15 preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A glide head comprising:
an aerodynamic means for riding above the
surface of a spinning disc; and
a thermal detection means for detecting
thermal spikes resulting from contact
with an asperity.
2. A glide head comprising:
an air bearing surface; and
a first thermal transducer that is generally
planar, the thermal transducer being
oriented along the air-bearing surface.
3. The glide head of claim 2 wherein the air
bearing surface has contours.
4. The glide head of claim 3 wherein the contours
include rails oriented along the length of the glide
head.
5. The glide head of claim 3 wherein the thermal
transducers are located on the contours.
6. The glide head of claim 2 wherein the thermal
transducers are in electrical contact with electrically
conductive pads extending to the top surface of the
glide head.
7. The glide head of claim 6 wherein conductive
strips provide electrical contact between the thermal
transducer and the pads.
8. The glide head of claim 6 wherein the thermal
transducer is in physical contact with the pads.
9. The glide head of claim 2 wherein the thermal
transducer extends at least half of the distance between
the front edge of the glide head to the rear edge of the
glide head.

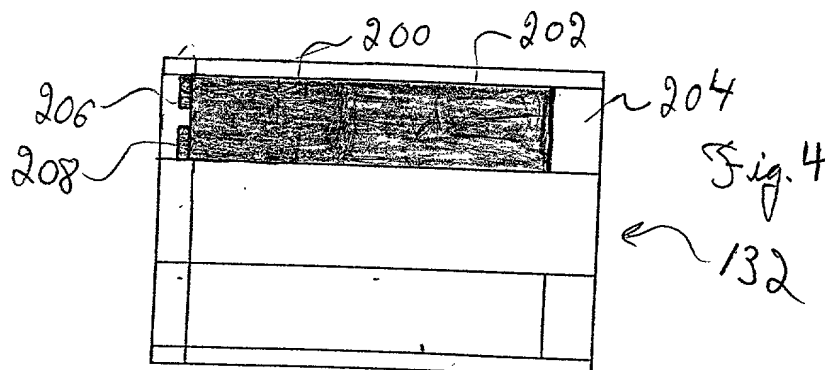
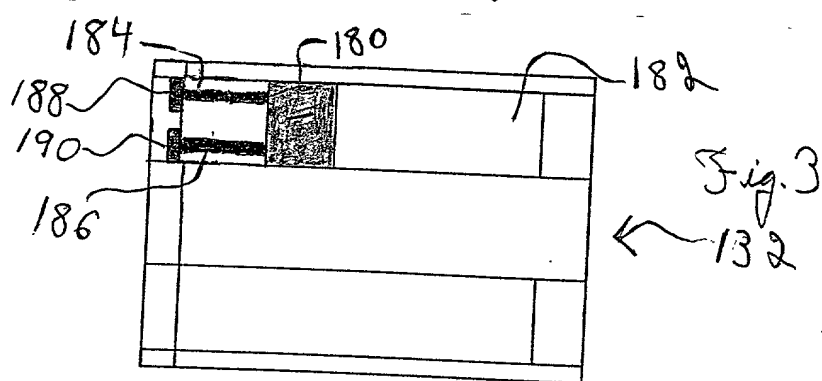
10. The glide head of claim 2 wherein the thermal transducer extends substantially from the front edge of the slider to the rear edge of the glide head.
11. The glide head of claim 2 further comprising a second thermal transducer.
12. The glide head of claim 11 wherein the first thermal transducer and the second thermal transducer share a common electrical ground.
13. The glide head of claim 11 wherein the first thermal transducer and the second thermal transducer are oriented along a contoured surface and the glide head further comprises electrically conductive strips in electrical contact with the thermal transducers, the strips being located on a plateau on the air bearing surface at a different level from the contour.
14. The glide head of claim 2 further comprising a piezoelectric transducer.
15. An asperity detection system comprising a glide head of claim 2.
16. A method of producing a glide head, the method comprising depositing a thermal transducer along an air bearing surface of the glide head.
17. The method of claim 16 wherein the deposition of the thermal transducer is performed onto the surface of a wafer prior to slicing a plurality of glide heads from the wafer.
18. The method of claim 16 wherein the deposition of the thermal transducer is performed onto the air bearing surface after the glide head is sliced from a wafer.
19. The method of claim 16 wherein the air bearing surface is contoured prior to the deposition of the thermal transducer.

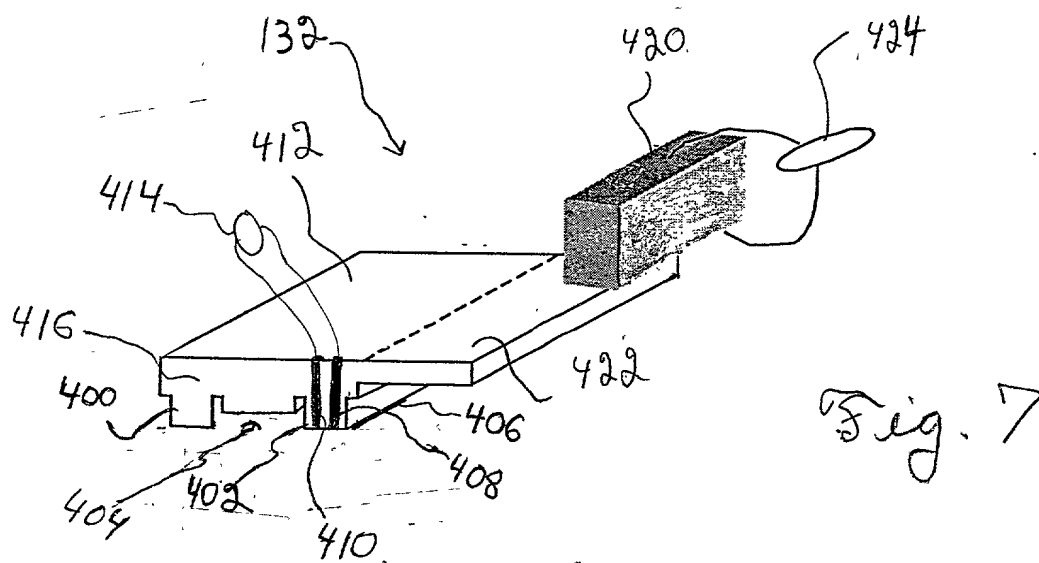
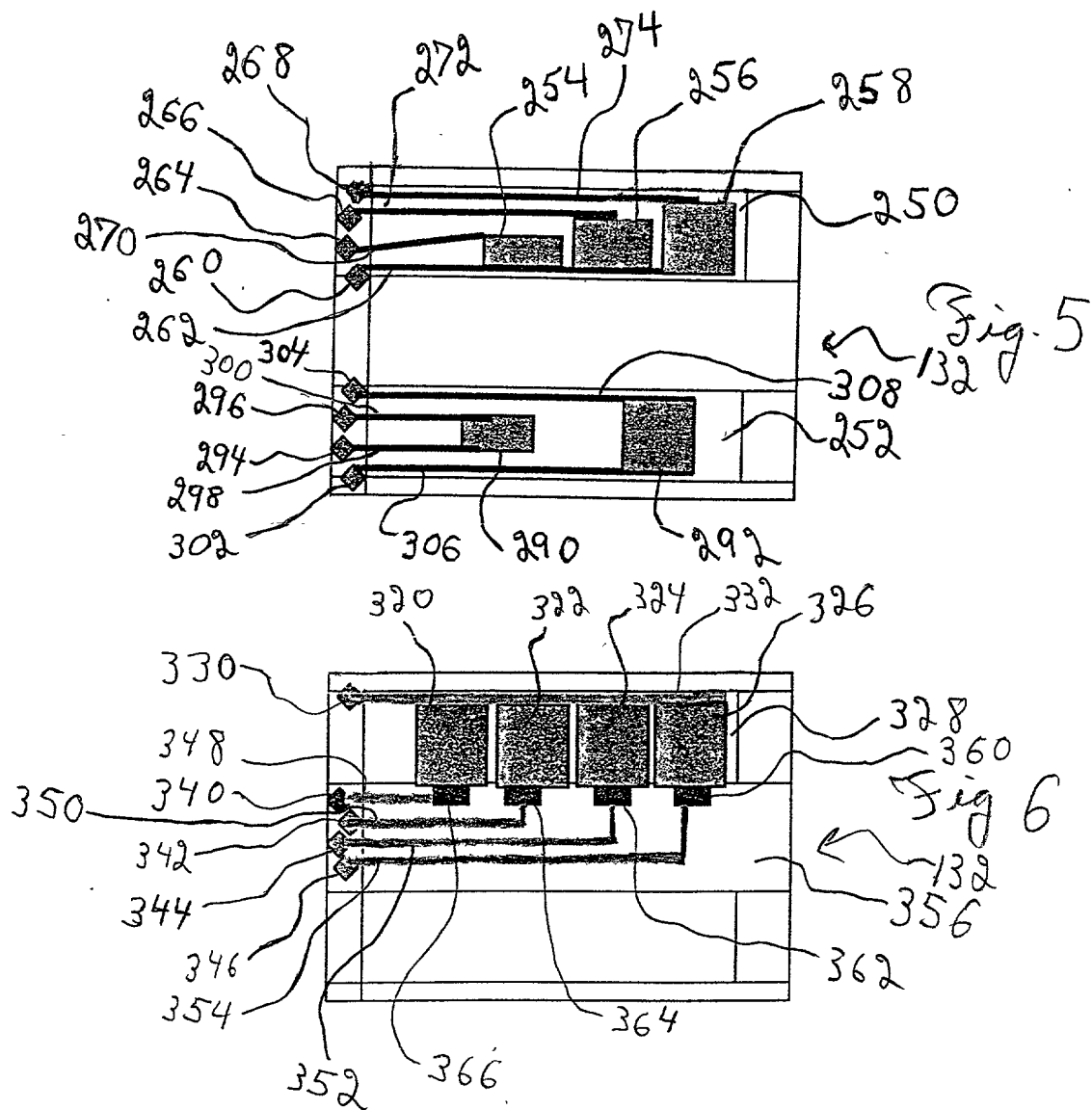
20. The method of claim 16 wherein the deposition is performed using a thin film deposition technique.

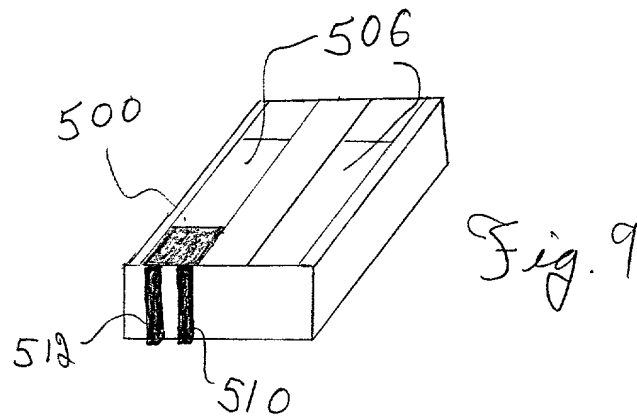
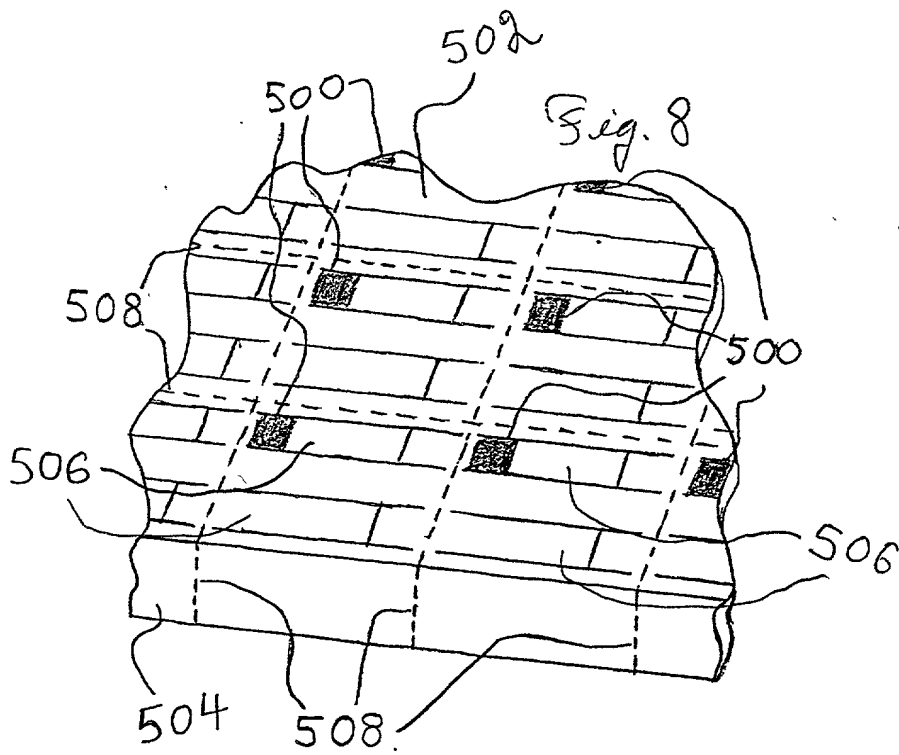
20. The method of claim 16 wherein the deposition is performed using a thin film deposition technique.

ABSTRACT OF THE DISCLOSURE

Glide heads for the detection of asperities on a storage disc have a thermal transducer oriented along the air bearing surface. The thermal transducer generally is in electrical contact with a circuit to measure the electrical resistance of the thermal transducer. Preferred methods of depositing the thermal transducer involve the deposition of the thermal transducer on the smooth surface of a wafer prior to the slicing of individual sliders.







COMBINED DECLARATION AND
POWER OF ATTORNEY
IN ORIGINAL APPLICATION

Attorney Docket No.

S01.12-0460

SPECIFICATION AND INVENTORSHIP IDENTIFICATION

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and joint inventor of the subject matter which is claimed, and for which a patent is sought, on the invention entitled GLIDE HEAD FOR ASPERITY DETECTION the specification of which,

(check one) X is attached hereto.

 was filed on as Appln. Serial No. .

 and was amended on .

 was described and claimed in PCT International Application
No. filed on and as amended under PCT Article
19 on .

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is known to me to be material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56.

PRIORITY CLAIM (35 USC § 119)

I claim foreign priority benefits under Title 35, United States Code, § 119(a-d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Number	Country	Day/Month/Year Filed	Priority Claimed
<u> </u>	<u> </u>	<u> </u>	Yes <u> </u> No <u> </u>
<u> </u>	<u> </u>	<u> </u>	Yes <u> </u> No <u> </u>

Prior Provisional Application(s)

I hereby claim the benefit under Title 35, United States Code §119(e) of any United States Provisional Application(s) listed below:

Number	Day/Month/Year Filed
<u>60/082,244</u>	<u>16 April 1998</u>
<u> </u>	<u> </u>

PRIORITY CLAIM (35 USC § 120)

I claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below. Insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 United States Code § 112, I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in Title 37 Code of Federal Regulations § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Appln. Ser. No.	U.S. Serial No. (if any under PCT)	Filing Date	Status
_____	_____	_____	_____
_____	_____	_____	_____

DECLARATION

I declare that all statements made herein that are of my own knowledge are true and that all statements that are made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY

I appoint the following attorneys and agents to prosecute the patent application identified above and to transact all business in the Patent and Trademark Office connected therewith, including full power of association, substitution and revocation: Judson K. Champlin, Reg. No. 34,797; Joseph R. Kelly, Reg. No. 34,847; Nickolas E. Westman, Reg. No. 20,147; Steven M. Koehler, Reg. No. 36,188; David D. Brush, Reg. No. 34,557; John D. Veldhuis-Kroeze, Reg. No. 38,354; Deirdre Megley Kvale, Reg. No. 35,612; Theodore M. Magee, Reg. No. 39,758; Peter S. Dardi, Reg. No. 39,650; and Robert E. Atkinson, Reg. No. 36,433.

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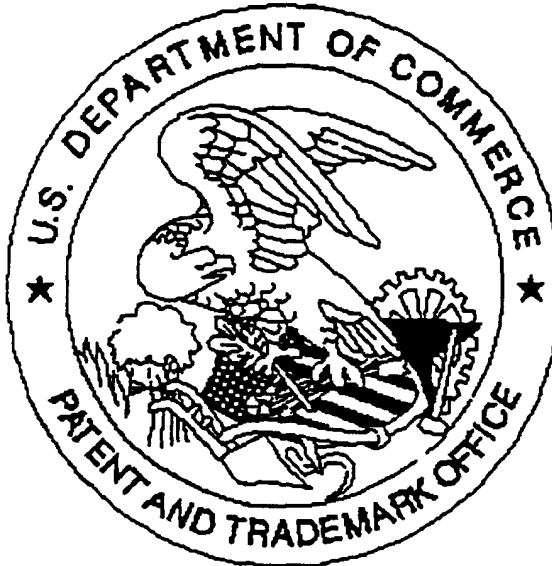
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